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OFFICE OF NAVAL RESEARCH LONDON (ENGLAND)
EUROPEAN SCIENTIFIC NOTES. VOLUME 5, NUMBER 20.(U)
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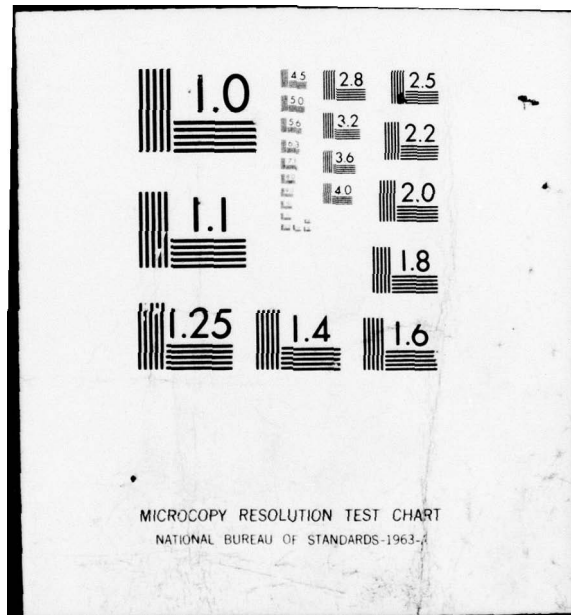


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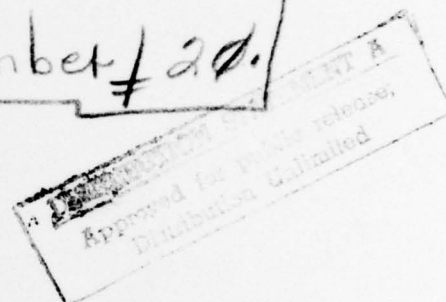


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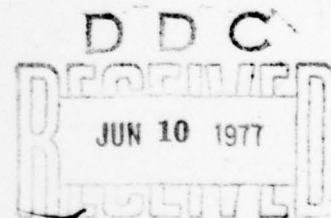
Volume # 5, Number # 20.
Vol. 5, No. 20



⑪ 15 October 1951

⑫ 12 p.

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Vol. 5, No. 20

<u>PHYSICS</u>	<u>Page</u>
Forbidden Bands in Hydrogen Spectrum	261
Low Angle Scattering of X-rays	262
European Commercial X-Ray Diffraction Equipment	263
X-Ray Sources	263
Curved Crystal Monochromators	264
Weissenberg Cameras	265
 <u>MATHEMATICS</u>	
Computer Program at ETH, Zurich	265
Digital Computations	266
Numerical Analysis	266
Analogue Devices	266
Research on Computer Design	267
Training	267
 <u>MISCELLANEOUS</u>	
New Publications	267
Blood Group Center	268
Cationic Polymerization	268
The Reactivity of Solids	268
The Physical Chemistry of the Proteins	269
Technical Reports of ONRL	269
Radiation Chemistry	269
 <u>PERSONAL NEWS ITEM</u>	270

AMERICAN EMBASSY

LONDON, ENGLAND

OFFICE OF NAVAL RESEARCH
London

EUROPEAN SCIENTIFIC NOTES

15 October 1951

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FORBIDDEN BANDS IN HYDROGEN SPECTRUM

J. van Kranendonk and R. B. Bird at the University of Amsterdam have recently calculated the intensity to be expected for the O-1 forbidden vibrational band of hydrogen in the infrared. This band has been observed by Crawford et al (Phys. Rev. 80, 469 (1950)) for hydrogen under pressure.

Their calculations have assumed that the band appears for two reasons, a distortion due to overlapping of the wave-functions of two colliding molecules, and a perturbation due to the permanent quadrupole moment of the molecules. Crawford had previously concluded from the pressure dependence of the observed absorption that the effect was primarily due to binary collisions.

The distortion term was calculated by a variational method using Rosen type wave-functions. The distortion, which decreases exponentially with separation of the molecules, is found to contribute principally to the Q-branch. The influence of the permanent quadrupole moment decreases as the inverse fourth power of the distance. The effect due to it is observed primarily in the S-branch.

The effects were first calculated for two interacting molecules and then summed over all the pairs of molecules. The separation function was obtained from the average intermolecular field deduced from the second virial coefficient.

The total calculated intensity of the band was about half the observed intensity. The investigators feel that this discrepancy is probably due to the approximations

of the variational method and the use of an over-simplified wave-function. The relative intensities of the various branches are in close agreement with those observed.

A detailed account of their work will appear soon in Physica. Bird has been at Amsterdam on a Fulbright fellowship.

LOW ANGLE SCATTERING OF X-RAYS

At Prof. A. Guinier's laboratory in the Conservatoire des Arts et Métiers, Paris, there is being carried on not only important metallurgical research (see ESN 4, 217 (1950) and 5, 220, 223 (1951)) but also a very promising series of studies of large molecules by the method of low angle scattering of X-rays. The work is being done mainly by Dr. Gerard Fournet, whose thesis has very recently been published partly in Acta Crystallographica 4, 293 (1951) and partly in Bull. Soc. Francaise Min. et Crist. 74, 37 (1951). Dr. Fournet's contributions to this important but comparatively little known technique include (a) a more powerful theory of X-ray scattering from liquids, (b) the development of an excellent apparatus for studying scattering down to angles corresponding to Bragg distances of nearly 1000 Angstroms, and (c) preliminary studies of hemoglobin, serum albumin, hemocyanin, and several other such molecules.

Dr. Fournet's theoretical contribution may be described as follows. The theory of Zernike and Prins relates X-ray scattering from a solution to a function $P(r)$, which expresses the probability of finding two molecules separated by a distance r , but which could not previously be related to the more elementary physical properties of the solution and which was therefore of little use in determining structure from scattering. Fournet has in effect shown how to calculate $P(r)$ from the structure of the molecules, the intermolecular force potential, the density of the solution, and the temperature. His work, incidentally, leads him to the conclusion that it is incorrect to suppose, as is often done, that a maximum in the scattering curve indicates that the corresponding Bragg distance is a most probable distance between molecules. This is because the scattering at any given angle depends upon the form of $P(r)$ for the entire range of r .

Fournet's apparatus consists of a rotating target high intensity tube (35 kv, 45 ma) with a double curved-crystal monochromator. He claims that the apparatus is easy to assemble and keep in adjustment. His exposure times are of the order of an hour.

Thus far he has not announced any results which involve the full power of his theory, but he hopes before long to be able to do so. His results so far include estimates of the radius of gyration of the horse hemoglobin molecule (which confirm the molecular dimensions given by Perutz), a study in which the action of urea on hemoglobin was followed as a function of time, a study on red blood corpuscles indicating that there exists a definite internal structure, a study of horse serum albumin fixed with copper which suggests strongly that the solution contained both unmodified albumin molecules and larger particles due probably to copper "bridges", and similar studies of horse euglobulin and pseudoglobulin, hemocyanin, and human hemoglobin.

EUROPEAN COMMERCIAL X-RAY DIFFRACTION EQUIPMENT

X-Ray Sources

Hilger and Watts, Ltd., 48 Addington Square, London, S.E.5, are now manufacturing the ultra-fine focus demountable tube designed and described by Ehrenberg and Spears (Proc. Phys. Soc. B64, 67 (1951)). The complete equipment including tube, vacuum system, power supply, and control panel costs about \$2500, while the tube and diffusion pump alone can be bought for about \$750. The outstanding feature of this tube is the very small size of the focal spot on the target; a circular focus of 40 μ diameter is easy to obtain, and there seems to be no reason why a line focus of width less than 0.1 mm should not be obtainable by a simple change of the shape of filament and focussing shield. The very small spot size permits much more effective target cooling, so that the maximum mean load is about 8 KW/mm² instead of about 0.1 KW/mm² for ordinary sealed-off tubes, with a corresponding increase in brilliance and reduction in exposure time. Experiments at Birkbeck College, London, indicate that ordinary X-ray diffraction photographs can be obtained with exposures as little as 1/20 of those previously used. The small spot also makes the tube attractive for microradiology.

The design is very simple, for the focussing is entirely electrostatic, and there are no intermediate

potentials required. A slight disadvantage is that it is the target which is at high potential. A tube has been in use at Birkbeck College for over a year with negligible trouble.

Etablissements Beaudouin, 1 and 3 rue Rataud, Paris 5, are manufacturing three models of a medium fine-focus demountable tube, priced at about \$420, \$590, and \$600. The tubes differ primarily in outward appearance, amount of adjustment possible during operation, and protection of the operator from the high voltage. All the tubes have targets with four different materials, any of which can be brought into position during operation. Minimum dimensions of the focal spot are 0.1-0.2 mm, achieved by electrostatic focussing. The earliest and cheapest of these models is in extensive use in French laboratories and has an excellent reputation for reliability, some users stating that they can be run continuously for many days without trouble.

Beaudouin also manufacture a power supply and control panel, priced at about \$1800, and also a rotating disk high-vacuum pump, with the advantage of achieving high vacuum very rapidly, priced at about \$570.

The Compagnie Générale de Radiologie, 34 Boulevard de Vaugirard, Paris 15, in addition to its fairly standard CRISTALLOBLOC demountable tube unit, has recently begun manufacturing what is probably the first sealed-off medium fine-focus tube. The pre-production model of this tube, which has a line focus of about 0.4 mm width, has been in use in Prof. Guinier's laboratory at the Conservatoire des Arts et Métiers, Paris, for about a year, and is much liked there. To date, it has run for over 1000 hours without difficulty, even though on one occasion the water-supply was accidentally stopped for half an hour.

Curved Crystal Monochromators

Curved quartz crystal monochromators, of the asymmetric type proposed by Guinier (Comptes Rendus 223, 31 (1946)) to permit an increase in crystal-film distance at the expense of source-crystal distance, are available from the Compagnie Générale de Radiologie. Two models can be supplied, one for Mo radiation, and the other for Cu, Co, Fe, or Cr radiation. The monochromators are complete with mounting and adjusting devices.

Weissenberg Cameras

The Unicam Weissenberg is well known in the United States. In their most recent model (price in England, \$840), they have adopted a lead-screw camera drive of very good design, but have retained the reversal-by-impact system of their earlier models.

A Weissenberg camera, designed by Prof. E. G. Cox of Leeds University, is now being manufactured by Research Engineers, Ltd., Northampton Grove, London, N.1, price about \$1400 in England. The camera has unusually good accessibility and flexibility.

The integrating Weissenberg, designed and described by Prof. B. H. Wiebenga of Groningen, The Netherlands (Acta Cryst. 3, 265 (1950)), is being manufactured by Nonius, Leeuwenhoeksingel 69, Delft, The Netherlands, price \$1570 in The Netherlands. The integrating feature of this instrument makes it possible to measure X-ray intensities with an accuracy of about 5 percent, at much greater speed than with a Geiger counter. The design and construction appear to be very good. Finally, LKB-Produkter, Box 12035, Stockholm, Sweden, are manufacturing a Weissenberg of the Buerger design, price about \$1400 in Sweden.

COMPUTER PROGRAM AT ETH, ZURICH

Last summer the Institute for Applied Mathematics of the Swiss Federal Institute of Technology (ETH), Zurich, moved into permanent quarters and put into operation its relay computer, designed and constructed for the ETH by the German engineer Konrad Zuse in close consultation with the Institute's staff (ESN 4, 155 (1950)). This machine, in somewhat modified and now completed form, is the one first described by R. C. Lyndon ("The Zuse Computer", Math. Tables and Other Aids to Computation 11, 355 (1947)).

The Institute has aimed at the establishment of a balanced computing program based on a small staff operating highly reliable machines, solving problems by running at full capacity with a minimum of supervision. This goal has now been reached. The computer staff has not neglected the problems of training and publicity with the result that their work is remarkably well integrated into the scientific community and they are provided with a wide selection of suitable problems.

Digital Computations

One of the problems recently treated was a survey of the solutions of a tenth-order system of ordinary differential equations describing a servo control system. Two other problems were concerned with the solution of linear elliptic boundary value problems in two independent variables by means of suitably systematized relaxation procedures. The last of these, which has been on the machine during recent months, concerns the elastic deformations of a swept-back wing of rhomboidal shape subjected to various loads applied on either the leading or the trailing edge in the direction of the other pair of sides. Appropriate boundary conditions are formulated for the wing root while the other boundaries are free.

Numerical Analysis

Particular attention is being given to the theory of finite differences and related schemes used in the approximation of solutions of linear partial differential equations on grids of finite mesh. A relaxation method in the sense that it is based on a systematic reduction of the residues has been developed, which leads to the construction of canonical systems permitting the representation of any particular solution in the form of a suitable linear combination. This procedure, originally proposed by Prof. E. Stiefel, Director of the Institute, is to be published in the January issue of the Zeitschrift für Angewandte Mathematik und Physik, which constitutes the principal publication outlet for the Institute.

Analogue Devices

Dr. A. P. Speiser has made a systematic study of the approximate realization of arbitrary functional relations by dc networks containing only linear potentiometers and resistances. The results have been applied to the development of a device simulating the manner in which the water levels of the lakes of Neuchâtel, Murten, and Biel depend on (1) the water levels at a recent earlier time (e.g., 24 hours ago), (2) the amount of water received in the intervening interval by each lake, and (3) the size of inter-connecting channels. This device is now being used to compute the day-to-day water level history during the last ten years which would have resulted had various proposed channel systems been in operation.

Research on Computer Design

Work is underway to determine the limits to which performance and capacity of relay computers can be pushed. The established engineering reliability of this type of computer element justifies the provision of complex and varied facilities. The most economical realization of these facilities raises interesting and difficult problems in combinatorial mathematics. A built-in multiplication table, for example, requires switching networks for multiplication of a given number with each of the ten digits. Minimal solutions have been worked out for all but the multiplier 3. Once found, this facility is useful also for an economical division routine. Among all procedures in which some multiple of the divisor is subtracted from the dividend until a negative result is obtained and then the divisor is successively added until the sign changes once more, the one requiring on the average the fewest steps is found to be the one where the multiple subtracted is three times the divisor.

Training

A comprehensive course on numerical analysis for inclusion into the regular mathematics curriculum of the ETH has been planned during recent months. It will be given by the Institute's staff for the first time this fall. Its primary purpose is to provide a sound foundation in the classical aspects of mechanical computations. Laboratory sessions, employing a systematically accumulated collection of twenty-odd desk computers of various European makes, will supplement the lectures. An enrollment of about 400 students is expected.

NEW PUBLICATIONS

An important new publication has been announced by the Royal Tropical Institute in Amsterdam, "The Anopheline Mosquitoes of the Indo-Australian Region" by M. J. Bonnewepster and Prof. N. H. Swellengrebel.

The manuscript is a compilation of the anophelines of this area and each species is illustrated with terminalia patterns and a short description of the species relative to the taxonomic characteristics, bionomics, distribution, and relation to disease.

Pre-publication costs are 25 Dutch Guilders (about \$7.00) and orders can be placed through the Secretary, Royal Tropical Institute, Department of Tropical Hygiene and Geographical Pathology, Mauritskade 57, Amsterdam, The Netherlands.

BLOOD GROUP CENTER

A research center to be known as the Nuffield Blood Group Centre of the Royal Anthropological Institute will be established in London about 1 January 1952. A grant of £14,000 has been made by the Nuffield Foundation.

The new center will classify the large and rapidly growing body of data on the distribution of the human blood groups throughout the world, assess it statistically, and make the results available to anthropologists and other research workers. It will also carry out and stimulate observations in this country and abroad, and it will continue the classification of British blood donors which is now in progress. The blood groups are among the few clear-cut characteristics which show a wide variation in frequency even in a country as small as Great Britain, and classified data about them will be needed to establish the anthropological element in the etiology of any disease. The new center, while primarily catering for anthropologists, may thus make an important contribution to medical research. The center will be at the Institute, 21 Bedford Square, London, W.C.1.

CATIONIC POLYMERIZATION

An informal Conference on Cationic Polymerization will take place at University College of North Staffordshire, Keele, North Staffordshire, England, on March 24-26, 1952. The Conference will deal mainly with the mechanism and kinetics of cationic polymerization and with the chemistry of complexes formed by metal halides with olefins and other organic molecules.

Further information can be obtained from Dr. P. H. Plesch of the above address.

THE REACTIVITY OF SOLIDS

An International Congress on the Reactivity of Solids will take place in Gothenburg, Sweden, on June 9-13, 1952. The meeting will deal with a wide range of theoretical and experimental problems on refractories, ceramics, metallurgy (including powder metallurgy), glass, and reaction mechanisms in the solid state.

All communications regarding the Symposium should be directed to Ingeniörsvetenskapsakademien, Box 5073, Stockholm 5, Sweden.

THE PHYSICAL CHEMISTRY OF THE PROTEINS

The Colloid and Biophysics Committee of the Faraday Society is organizing a General Discussion on the Physical Chemistry of the Proteins. The Discussion will take place in Cambridge on August 6-8, 1952, and will deal with the following topics: Low Molecular Weight Proteins; High Molecular Weight Proteins; Protein Interactions; Conjugated Proteins.

TECHNICAL REPORTS OF ONRL

The following reports have been forwarded to ONR, Washington, since the last issue of ESN;

- ONRL-67-51, "Research in Molecular Spectroscopy and Structure at the University of Bologna" by G. J. Szasz
- ONRL-68-51, "Faraday Society Discussion on the Size and Shape Factor in Colloidal Systems" by G. J. Szasz
- ONRL-73-51, "Electron Transfer in Solution and at Electrodes" by G. J. Szasz
- ONRL-76-51, "The Direction of French Developments in Structural Aluminum Base Alloys" by A. J. Shaler
- ONRL-84-51, "Bactericidal and Insecticidal Activity of Iridomirmecina" by LCdr. W. J. Perry
- ONRL-88-51, "High Tin Aluminum Based Bearing Alloys" by A. J. Shaler

RADIATION CHEMISTRY

The next Faraday Society Discussion will deal with Radiation Chemistry, and will be held in Leeds, Yorkshire, on April 8-10, 1952. The main topics of discussion will be;

I. Primary Act

- (a) Mechanism of energy loss of fast charged particles.
- (b) Identification and spatial distribution of the species initially formed.
- (c) Theory of the stability of molecular ions, of charge neutralization, and of electron capture processes.

II. Secondary Processes

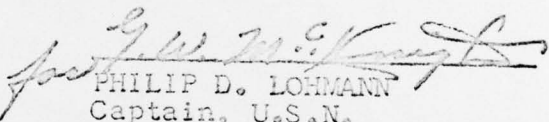
- (a) Radiation actinometry.
- (b) Direct action in one-component systems.
- (c) Radiolysis of water and other pure liquids.

- (d) Indirect action in aqueous systems containing a single solute.
- (e) Multi-solute systems and other solvents.

PERSONAL NEWS ITEM

Dr. Paul Vigoureux of the Admiralty Research Laboratory is visiting various Naval research laboratories in the U.S. for a period of six months. His headquarters will be the Naval Ordnance Laboratory, White Oak, Maryland. Vigoureux is a specialist in ultrasonics.

Prepared by the Scientific Staff
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